Space Weather Technical Forecast

Issued on Saturday 23 November 2024 at 00:38 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate Solar Activity

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with two M-flares, peaking M1.6 at 22/1546 UTC from AR3905 in the southeast. M1.0 flare was also observed from AR3906 near the southeast limb. These are the most complex regions on the disc, with AR3906 seeing complex looping above the region and potentially having a delta spot, although this is impossible to confirm due to its viewing angle. The other regions on the disc are all smaller and simpler.

No Earth-directed CMEs were observed.

Solar Wind / Geomagnetic Activity: Slow wind persisted through the period. Solar winds speeds measured by ACE at L1 were background to slightly elevated at 370-410km/s, with density near average or just below. Interplanetary Magnetic Field (IMF), Bt, was Weak to Moderate, between 5-10nT, peaking at 22/0821 UTC. The north-south component was also Weak to Moderate and variable in direction, ranging between +10nT and -9nT. Phi angle was mainly negative (towards the sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 eased after the enhancement on 21 Nov. The >10 MeV flux briefly peaked at S2 Moderate Solar Radiation Storm, reaching 125 pfu at 22/0355 UTC, before declining to fall below S1 Minor Radiation Storm by 22/2035 UTC and then to background by the end of the period. The >100 MeV proton level also became enhanced with event, declining to around 2 pfu at 22/0000 UTC and then to background by the end of the period. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background. The associated 24-hour fluence remained below Active, with 1.32e6 total pfu observed at 23/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with further M-flares expected, and a slight chance of an isolated X-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Slow wind conditions are expected to dominate, but with a chance of spells of slightly elevated solar winds from any connection to the fast winds of CH93, or more likely CH94. This most likely to occur on day 2 (24

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Nov). Geomagnetic activity is expected to be Quiet to Unsettled overall, but with a chance for spells of Active, mainly day 2 (24 Nov).

Energetic Particles / Solar Radiation: High energy protons are expected to persist at background, with only a very slight chance of enhancement from any of the regions currently on the disc. High energy electron flux is expected to be mainly background with the associated Active fluence remaining well below the Active threshold.

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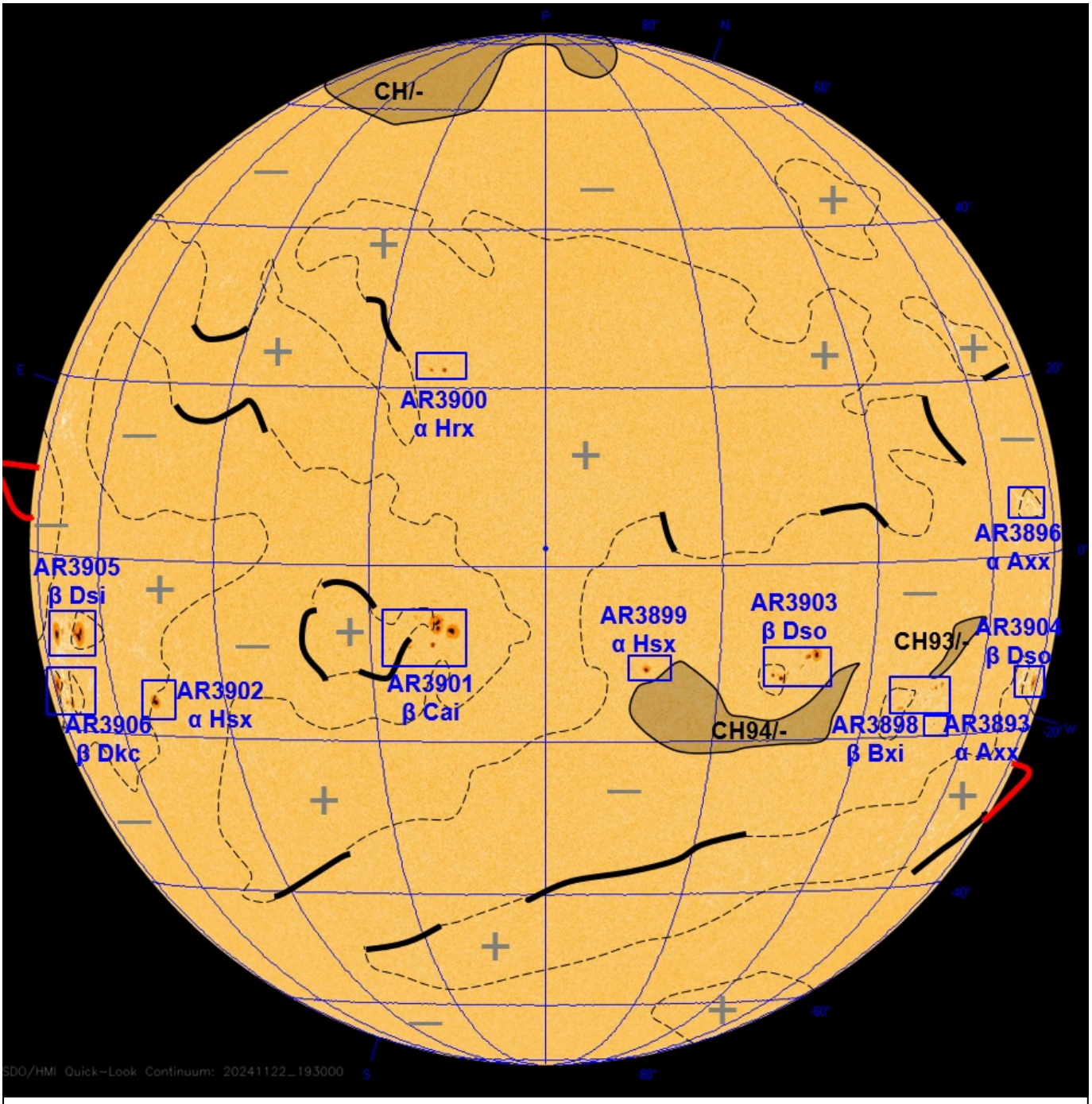
Figure 1: Solar Synoptic Map 22/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs.

The coronal hole forecast is currently low confidence, as both CH93 and CH94 are becoming harder to see due to the building of coronal loops, while MOSWOC Enlil continues to over-estimate the current conditions. Furthermore persistence from the previous rotation is contaminated by two CME arrivals. Given the time of year, and the weak appearance of the coronal holes any enhancement during the coming days is expected to be weak, perhaps most likely to occur on day 2 (24 Nov) from CH94 which is slightly larger and further east.

Geomagnetic activity is expected to be Quiet to Unsettled overall, but with a chance for spells of Active and a very slight chance of reaching G1 Minor storm, perhaps most likely on day 2 (24 Nov).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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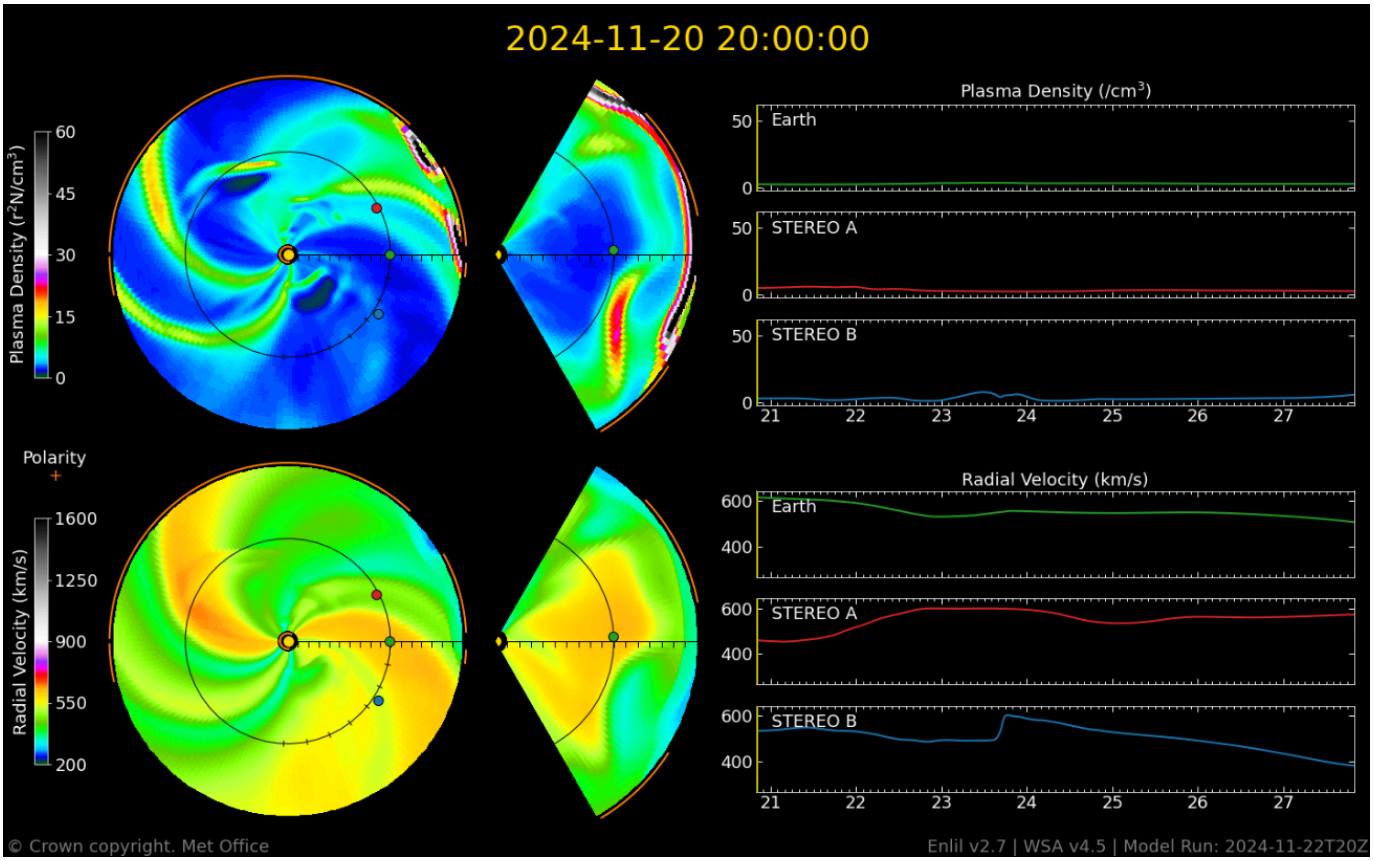
Figure 2: Enlil, showing a large and broad fast wind which is currently not observed.



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Radio Blackouts - X-Ray Flares

Solar activity is currently Moderate and expected to continue Moderate to Low, but with a slight chance of X-class flares, primarily from AR3906 in the southeast.

There are eleven regions currently on the disc, however the majority of these are small and simple with a couple of the smaller regions in the western disc now largely faded. The most notable groups are the new active regions that have rotated onto the southwest disc. AR3906 is the most complex of these, however details are still becoming apparent as it remains at an oblique viewing angle. This region is bright in other SDO imagery (i.e. aia imagery) and perhaps has a delta-spot although this is currently impossible to confirm. To the north of this, AR3905 has a simpler east-west aligned bipolar configuration, but was the source of an M-flare on 22 Nov, and will continue to have a risk of further such flares. There is also some brighter looping evident over the northeast solar limb in e.g. SDO aia-094, perhaps indicate of further regions to rotate onto the disc.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	Yes	70	70	70	70
Very Active	**R3-R5 (X Class)**	No	10	10	10	10

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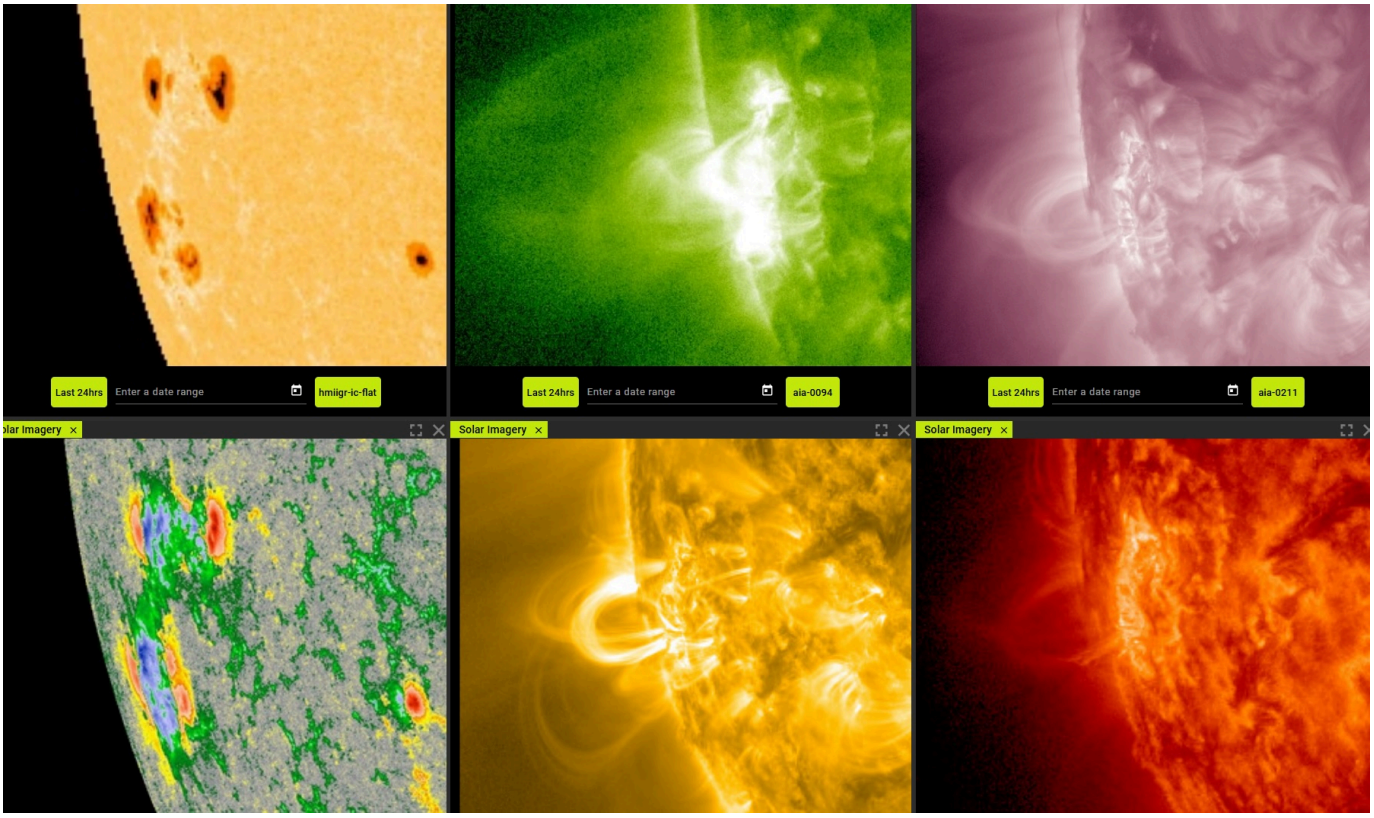
Figure 3: GOES 16-18 X-ray Irradiance

Figure 4: SDO hmi and aia imagery of the southwest disc, including AR3906 to the southeast. Further details likely to become apparent as this moves to a clearer view.



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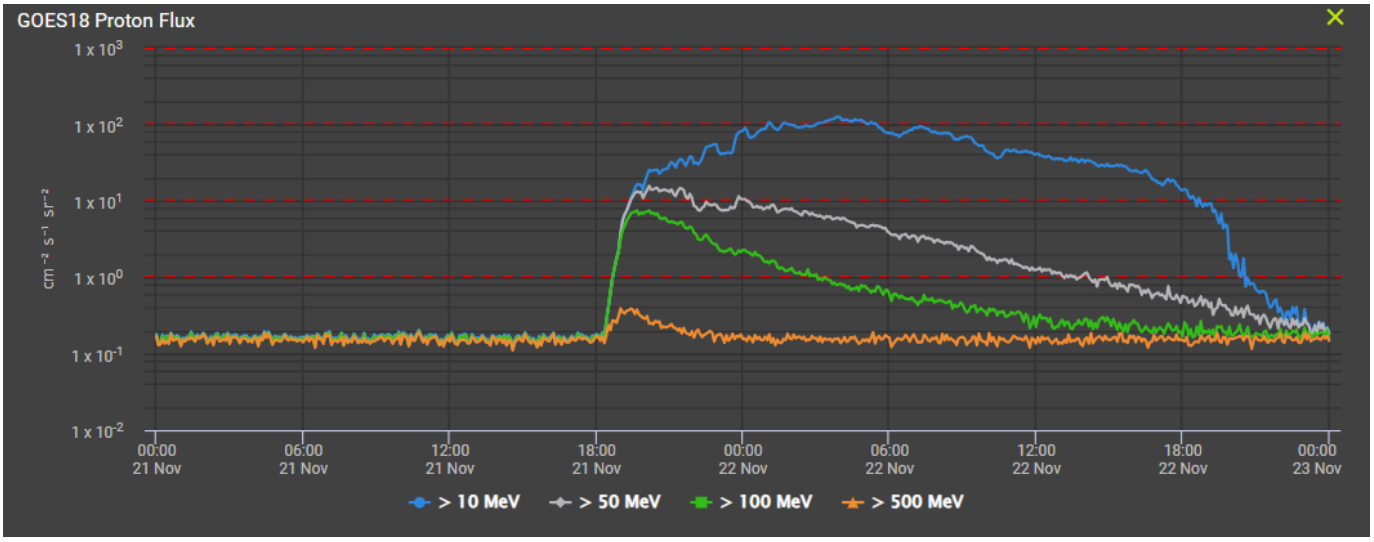
Solar Radiation Storms (High Energy Protons)

The recent enhancement to the GOES-18 Proton flux has now declined to background. This enhancement occurred due to a large eruption from over the west limb on 21 Nov, and was a relatively hard event with responses also observed in higher energy channels, including >100 MeV and >500 MeV. The likely source region, while impossible to observe and assess if it survived this event, could potentially produce further notable eruptions. However these are increasingly unlikely to influence Earth if they occur.

The regions currently on the visible disc are currently unlikely to produce observable proton events, with the most likely flare sources currently near the southeast limb. The observed proton Flux is subsequently expected to continue easing to background, and then persist at this level.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	5	5	5	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 5: GOES 18 Proton Flux 21-22 Nov for a number energy channels. Hard enhancement late on 21 Nov has now eased.



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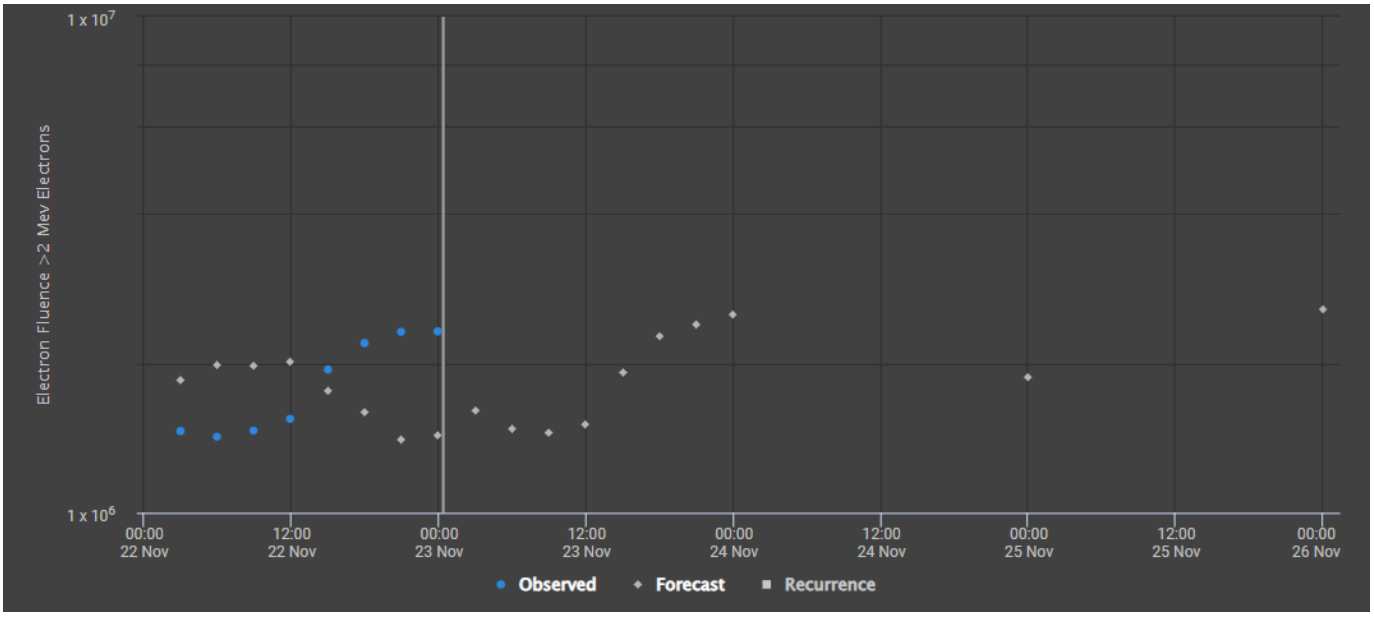
High Energy Electrons (≥ 2MeV)

Electron flux observed by GOES-16 at GEO has been at background, and is expected to persist at this level, with only very slight increases possible from any weak connections tot eh fast winds of CH93 or CH94, most likely later in the period.

The associated 24 fluence is expected to persist well below the Active level, with REFM providing good guidance.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

Figure 6: GOES 16 24 hr Electron Fluence and REFM



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